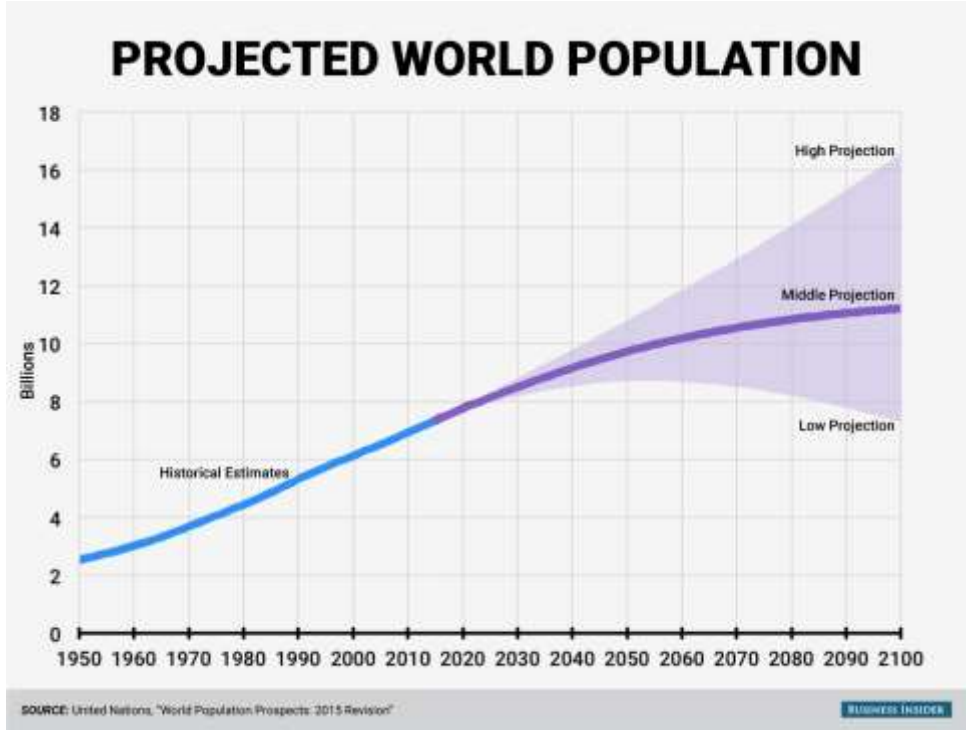
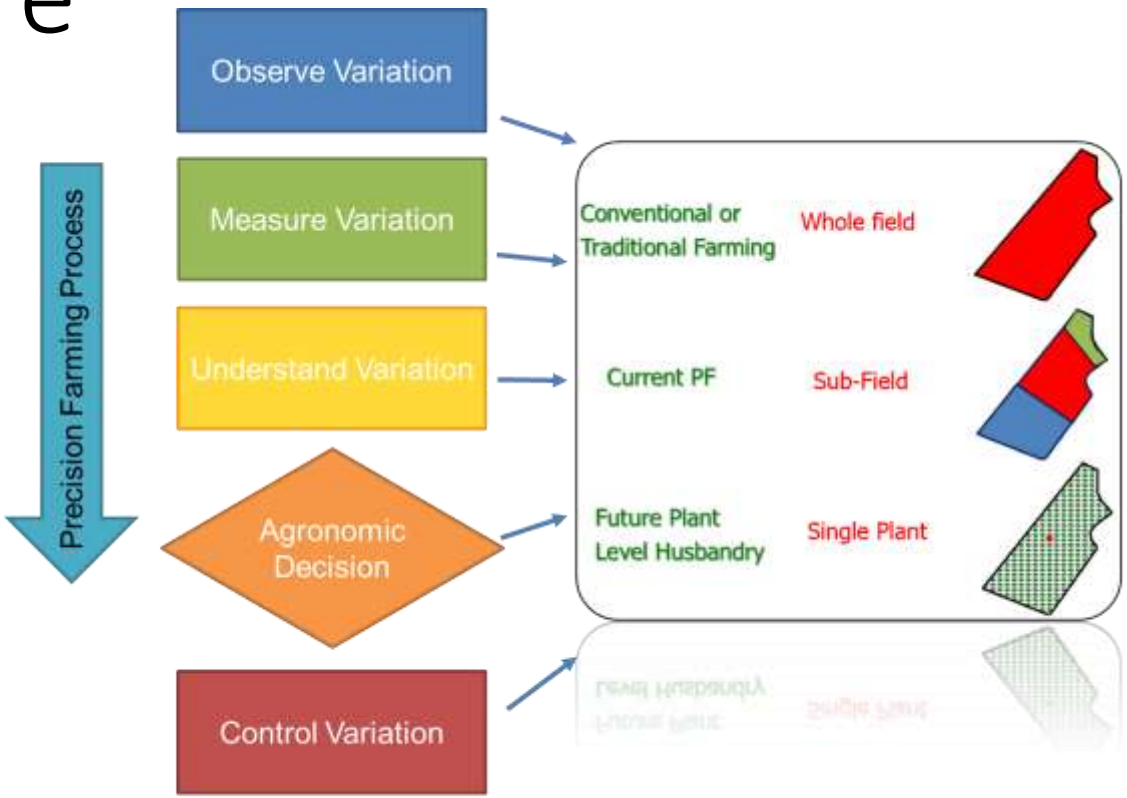
Future Farming:
precision, automation and connectivity

Kit Franklin – Agricultural Engineering Lecturer

Current aims of agriculture





- To feed a growing global population with reducing resources
- Improve sustainability: reduced waste & increase efficiency
- Adopt Precision Farming management methods: **4x Rights**

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Current Ag problems

Lack of resolution for Precision Farming

Cause

large machines

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Current Ag problems

large machines

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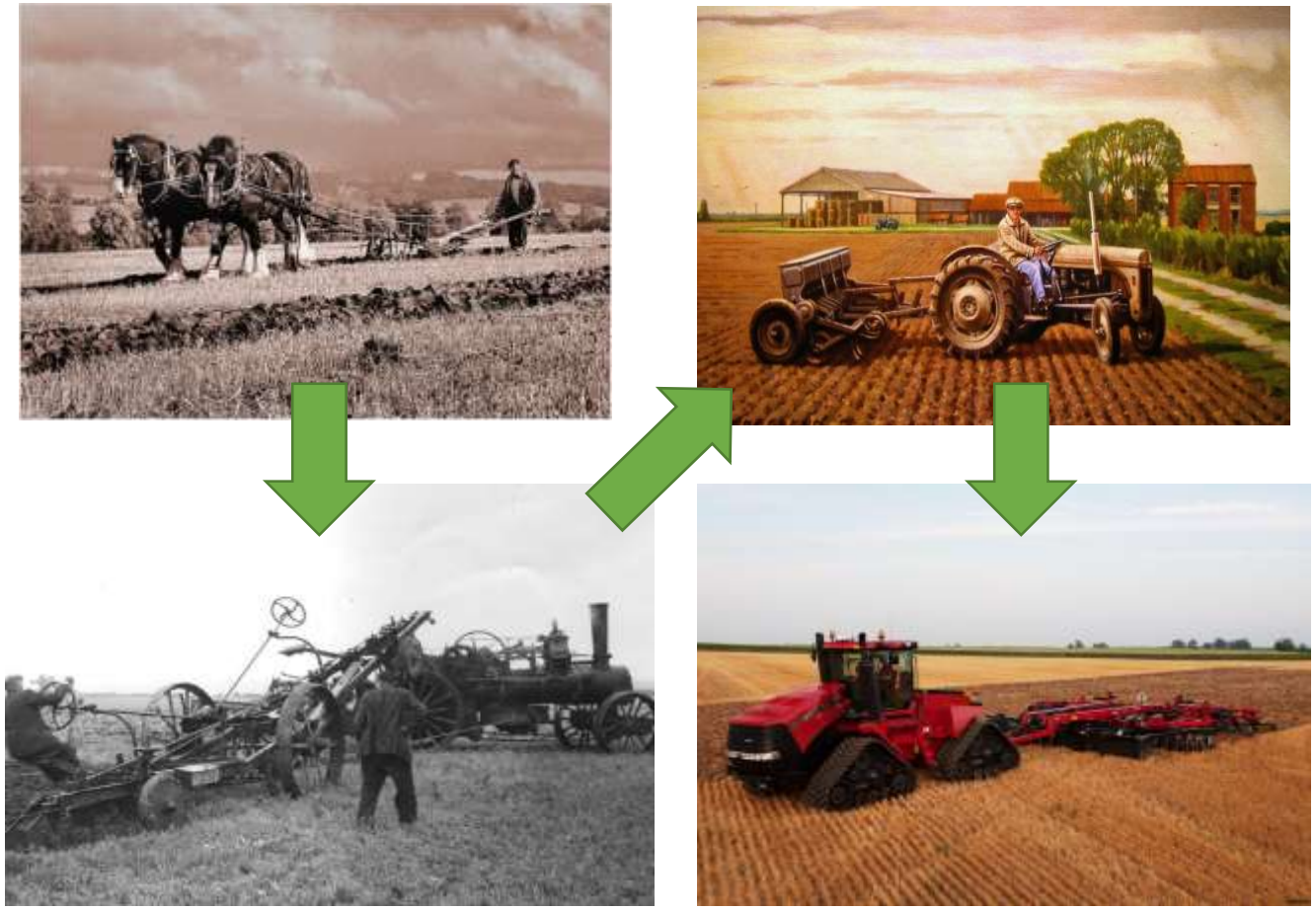
How have we got here



Mechanisation & Economies of Scale

Reduced rural labour = ever larger machines

Limited time windows = ever larger machines

One-upmanship = ever larger machines

More power **will** solve the problem

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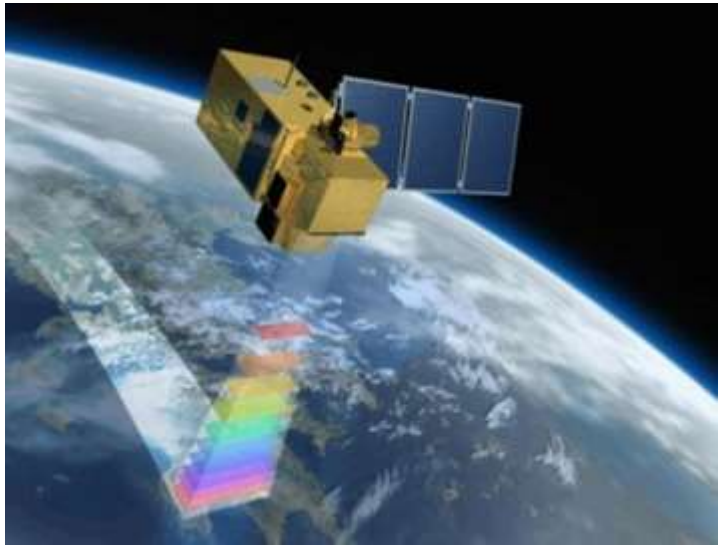
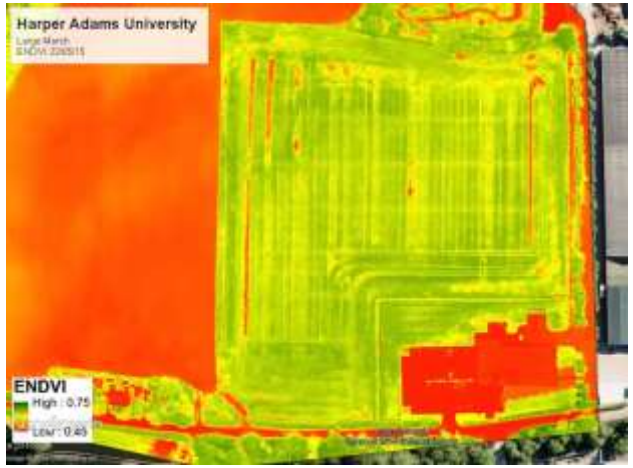
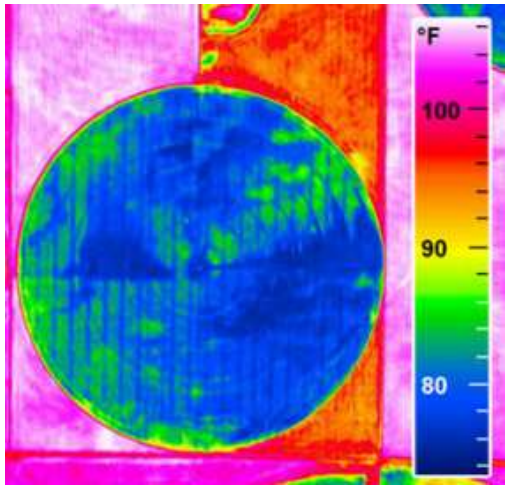
What does precision look like







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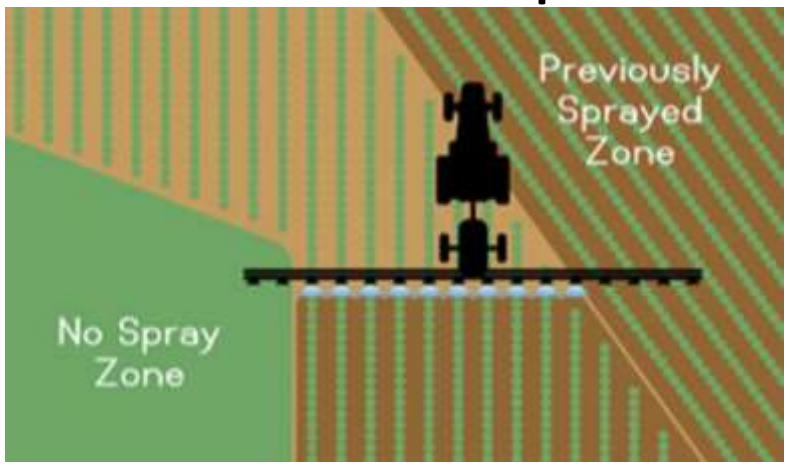
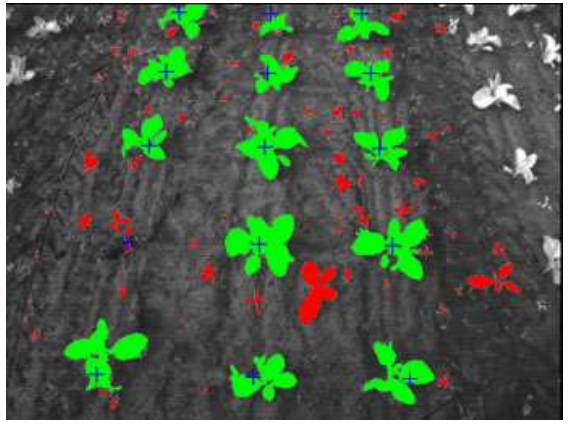
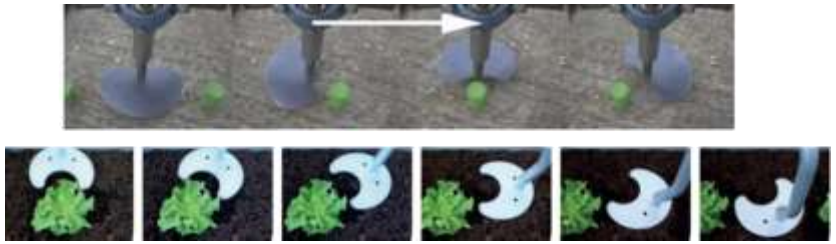
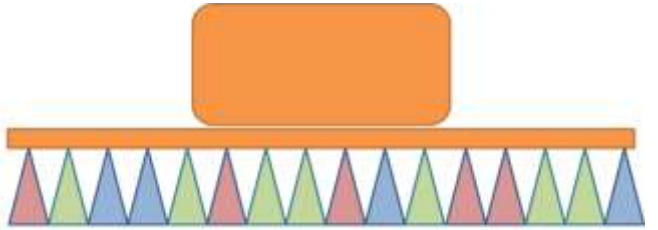
What does precision look like

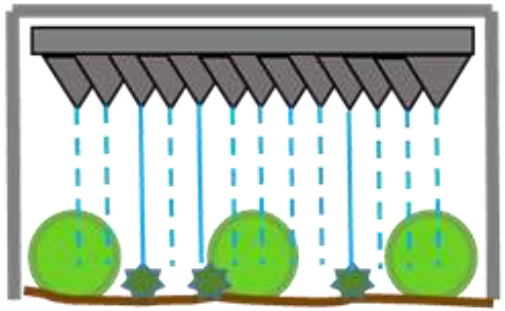


10-15% savings on inputs
Improved crop performance









>85% chemical savings with micro spot application

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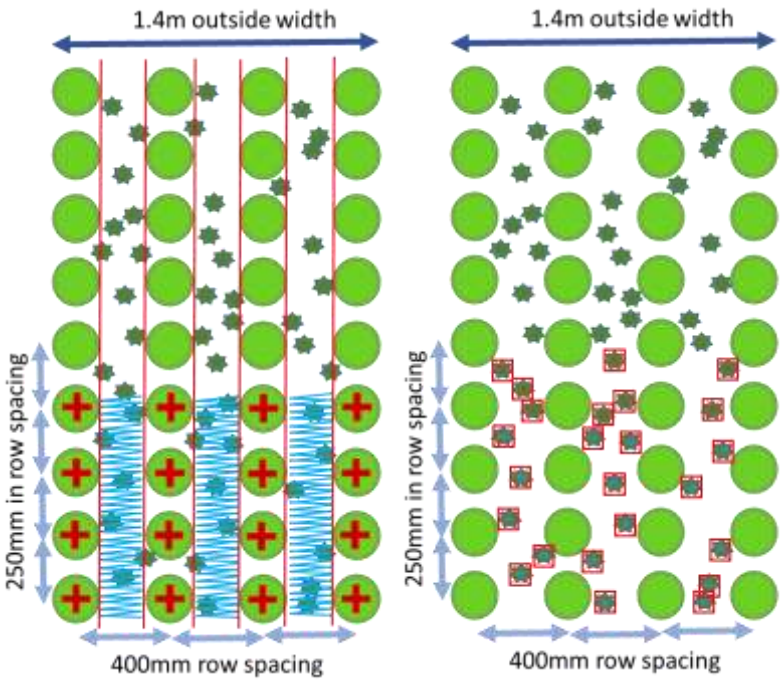
What does precision look like



Project Hyperweeding

WP2: Engineering of steerable laser ablation robotics

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MANCHESTER 1824 The University of Manchester

NATURALLY G's FRESH

syngenta

Innovate UK Technology Strategy Board

Hyperweeding

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A small robotic future

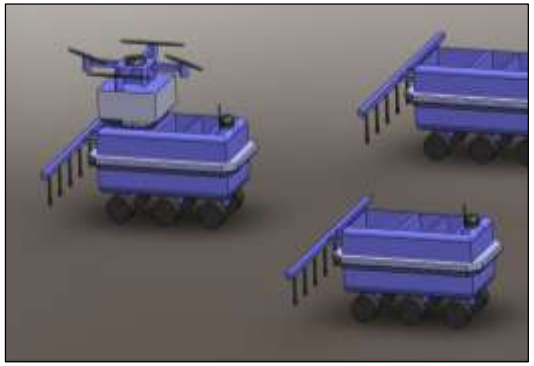
Increased resolution = improved PF = margin gain?

Reduced compaction (tackle cause) = increase yield?

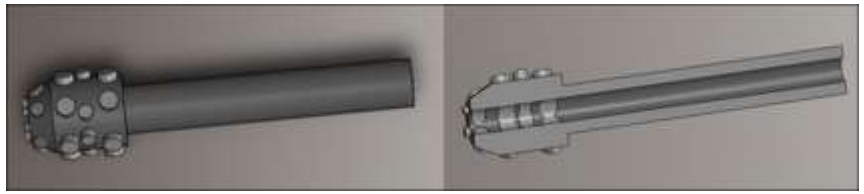
Robots operate in “swarms” = same area covered

Swarm requires management = job retained

Small vehicles are intrinsically safer



1875 ton/ha to 11.27 ton/ha

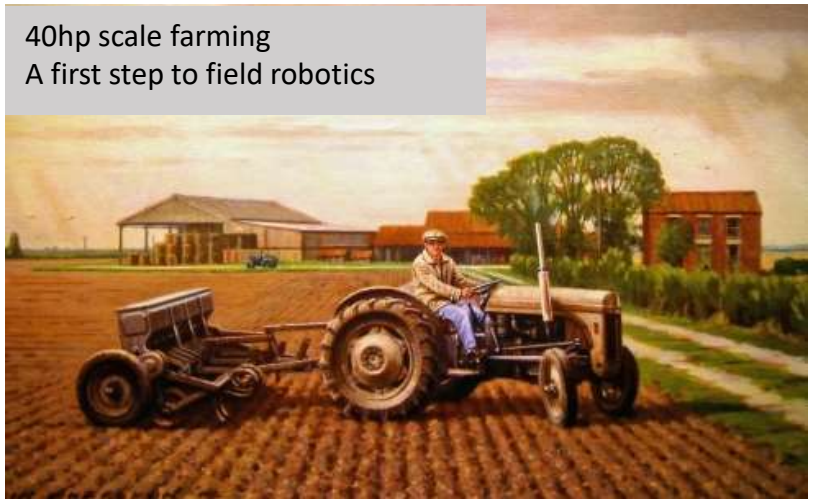


Over a 150 times reduction in soil movement

Energy implication???

Future plant scale robotic management

40hp scale farming
A first step to field robotics



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HandsFree Hectare

An Innovate UK funded collaborative feasibility study between:

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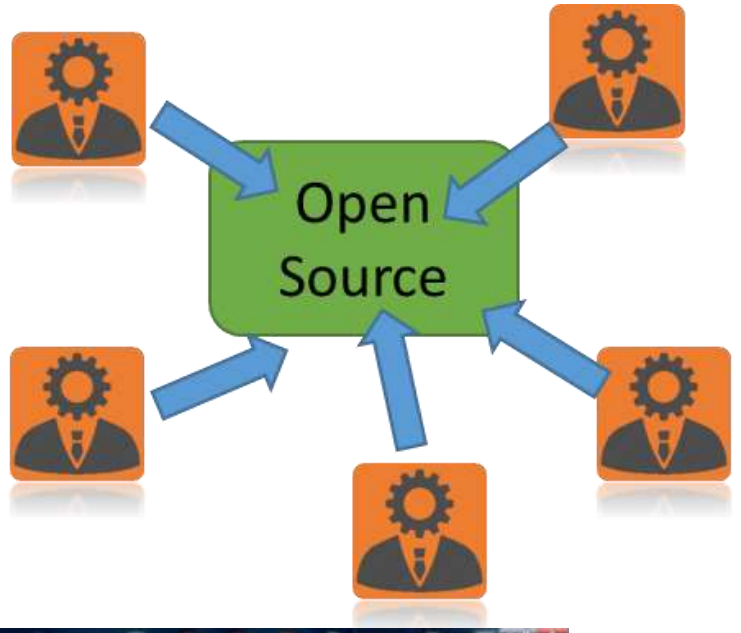
A different point of view



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Hands Free Hectare – world first

Project outline

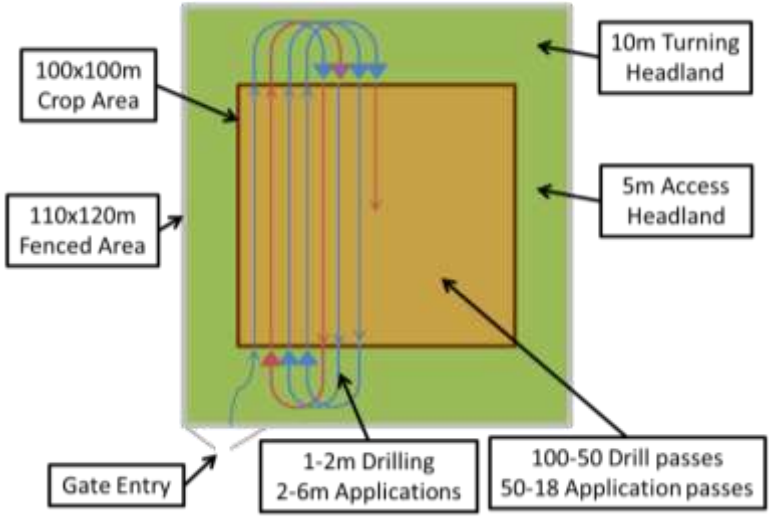
"Automated machines growing the first arable crop remotely, without operators in the driving seats or agronomists on the ground"

Project objective

1. World first automated field growing cycle: drilling, husbandry/agronomy and harvest
2. Challenge perception of automation capability and inspire through media coverage
3. Utilising machinery and technologies that are available and affordable **not** bespoke and expensive:

   Commercial compact Ag machinery

   "Open source" automation
4. 1 year project…. One chance - KISS!!



10,000m2 cropped area

10m x 5m grass margin

Level ground

No people

No obstacles

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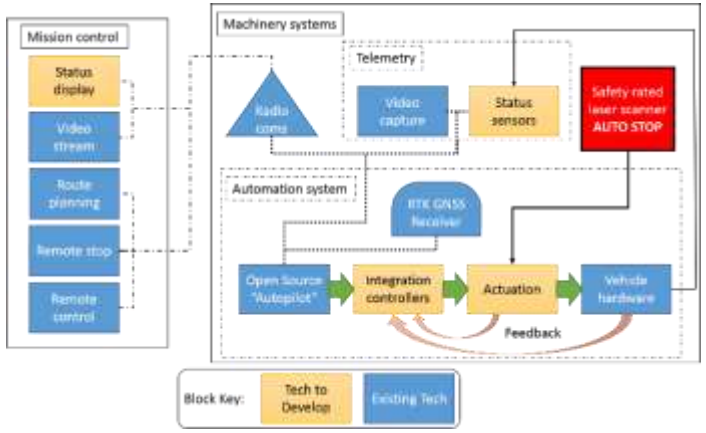
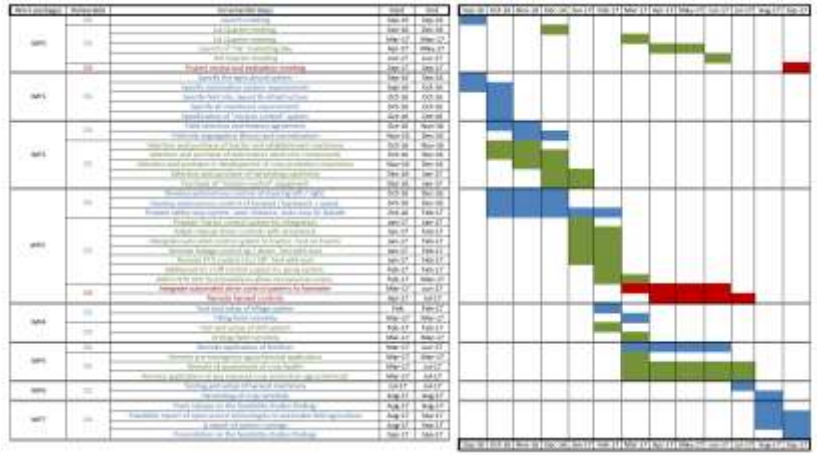
Hands Free Hectare – FUNDED

WHY did they back us: Innovate UK

1. Collaboration
2. World First
3. Value - £200k
4. Clear plan





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Hands Free Hectare – infrastructure

Middle Leasow


Safety fence


Ha and boundary layout


Field “mission control”

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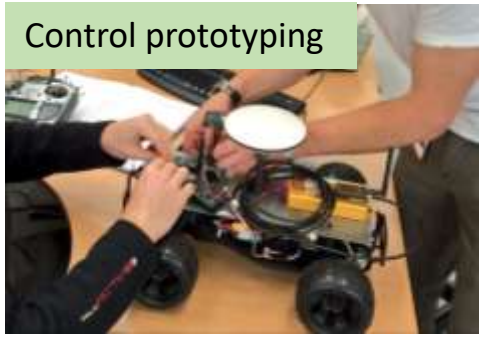
Hands Free Hectare – equipment

Control prototyping



Control actuation

Tractor 38Hp

Steering actuation

2m Combine harvester

6m Sprayer

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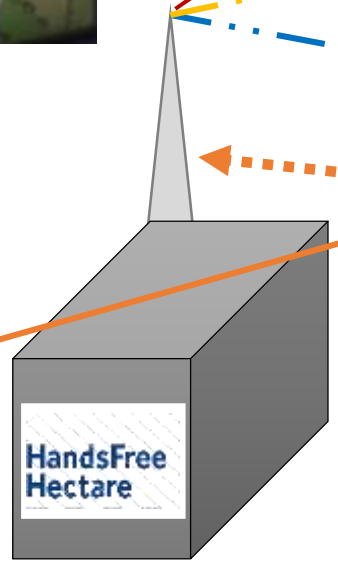
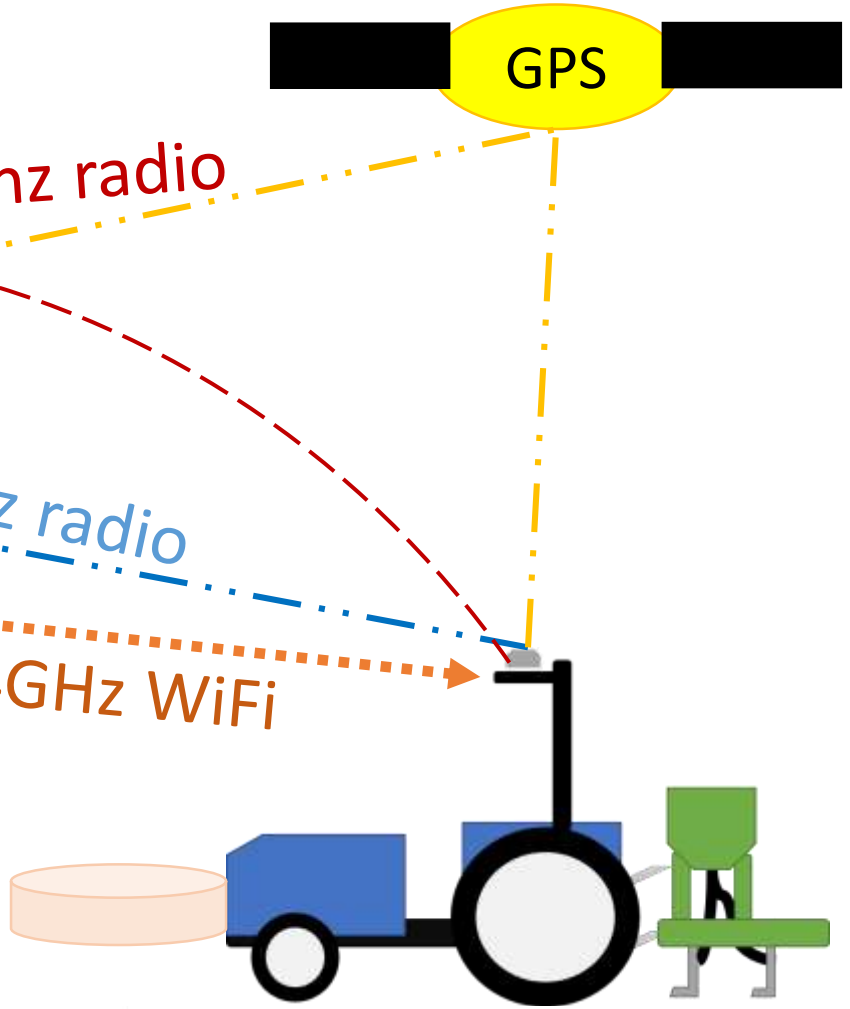
Hands Free Hectare – **current system**





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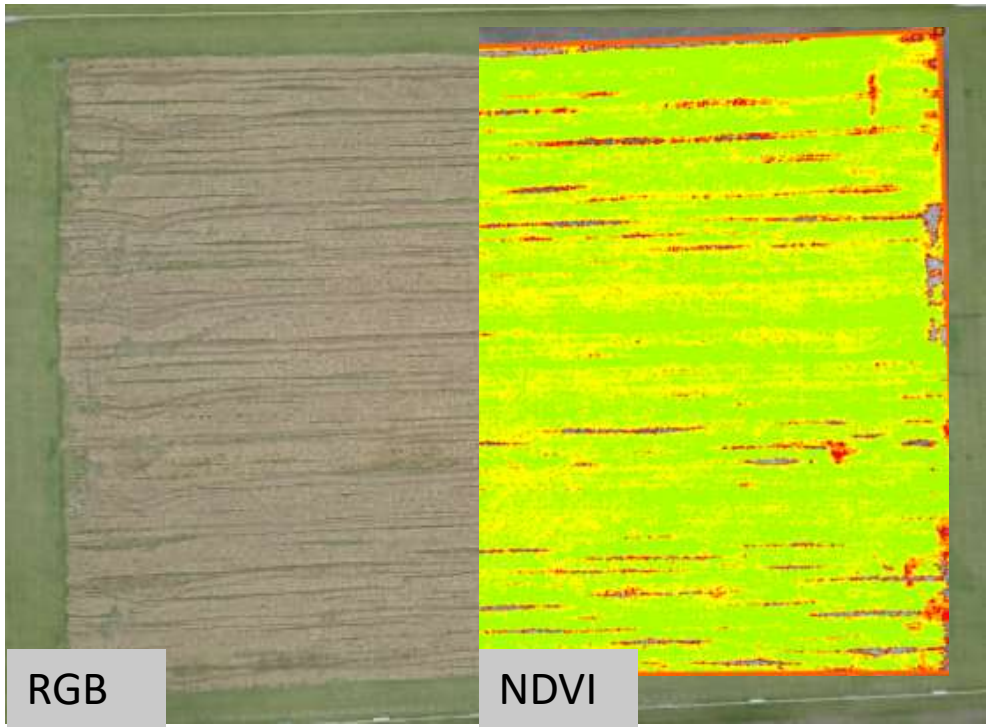
Hands Free Hectare – agronomy



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Implication – Cheaper precision farming tech

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Implication – A new industry sector

How long to commercialisation?

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Implication – Technology requirements… jobs

- Skilled fleet managers
- Agronomists – remote sensing
- Programmers
- Agricultural Roboticists

- Communication infrastructure development

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Implication – small team & budget innovation

- Collaboration
- “Skunkworks” model – SMEs & Corporates
- Utilising technologies from other industry
- “Youthquake” – for industry developments

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Impact

Department for Environment Food & Rural Affairs

Health and Harmony: the future for food, farming and the environment in a Green Brexit

Case study: Harper Adams University

The Agricultural Engineering Innovation Centre and the National Centre for Precision Farming at Shropshire's Harper Adams University conduct research and provide support to improve our understanding of precision farming methods.

In September 2017, Harper Adams researchers, working with Yorkshire-based Small Medium Enterprise (SME), Precision Decisions and other industry sponsors, completed a world first. They had successfully grown a crop of barley using only autonomous vehicles and drones and without a human setting foot in the field.

The "Hands Free Hectare" project was a major step in revolutionising how we feed the world whilst helping to protect the environment. To limit damage to the soil for future harvests, and increase efficiency, the team employed a small modified tractor and combine equipped with cameras, sensors and GPS systems. Drones monitored the field, while a robot "scout" collected plant samples for inspection. This research has attracted world-wide interest in UK innovation in agricultural practice, prompting international partners to work with the team and resulting in news coverage in over 80 countries to date.

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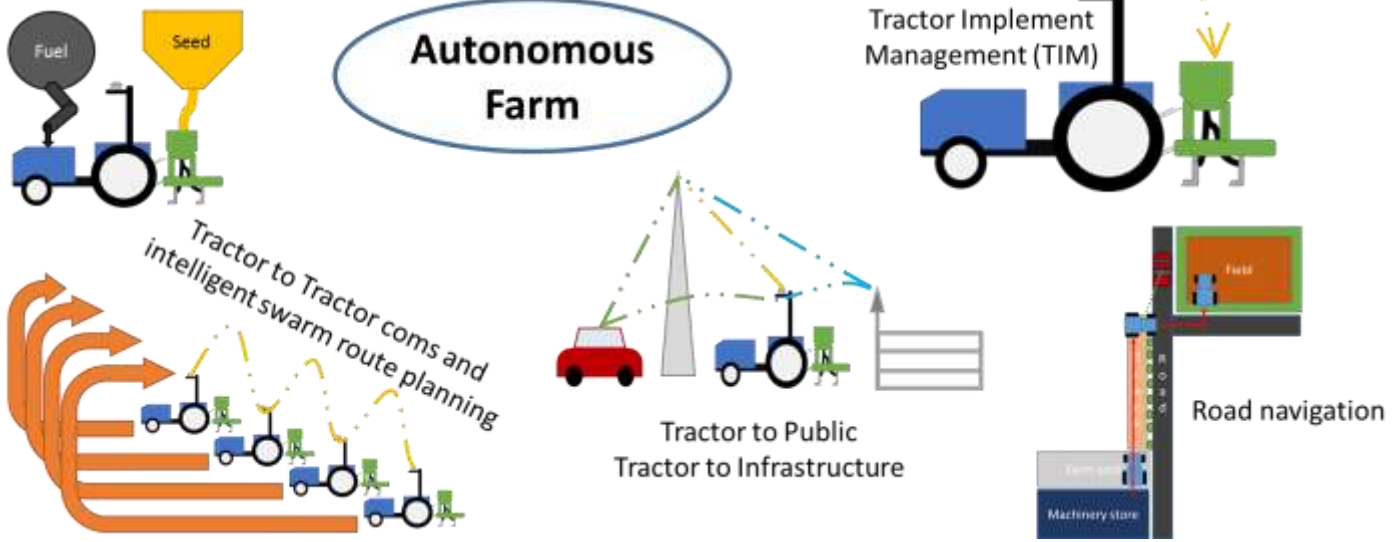
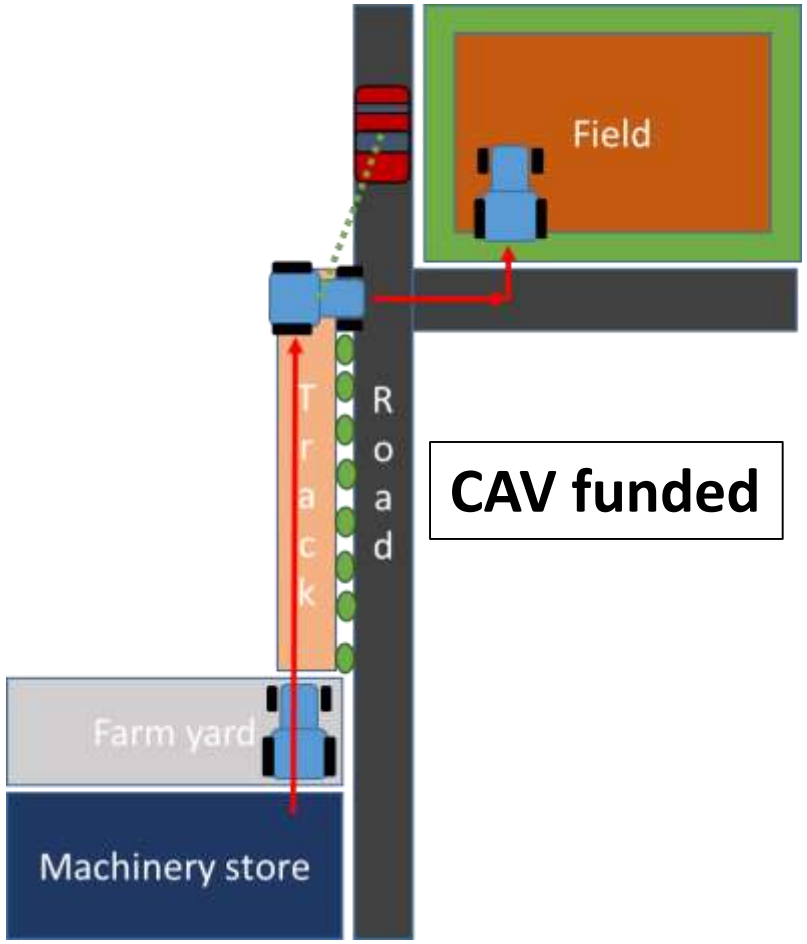
Critical elements highlighted by HFH

Themes:
1. **Navigation**
2. **Communication**
3. **Sensing**
4. **Smart implements**





CAV funded

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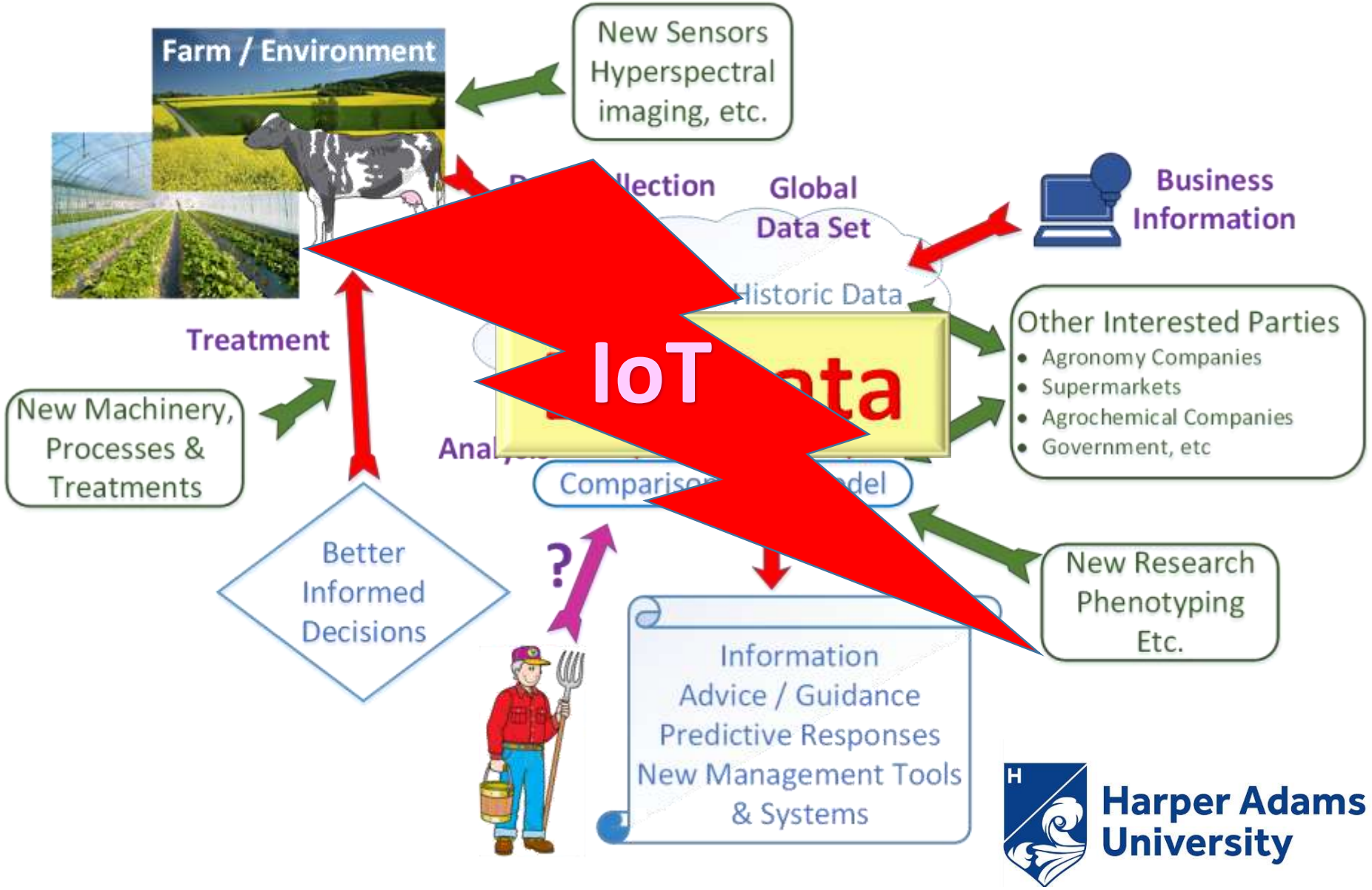
Agriculture 4.0

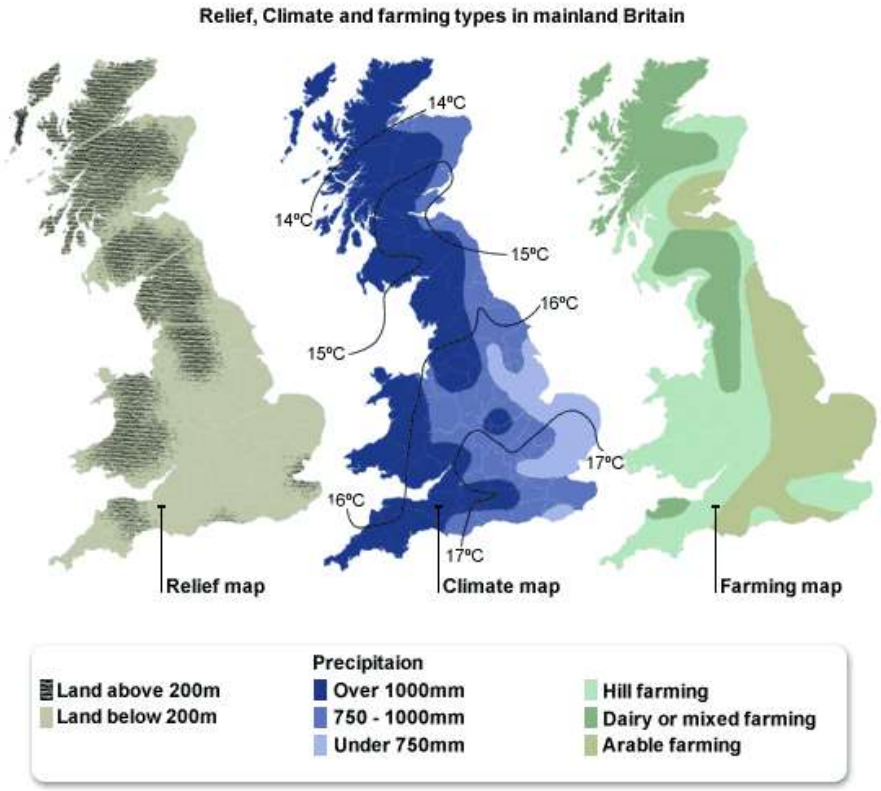


5G in agriculture – 100% coverage critical

Agricultural covers all regions and landscapes

Agri-Tech requires reliable communication

- Data transfer from farm office to the field (rate maps etc.)
- IOT sensors for remote monitoring of crops and livestock
- Vehicles telemetry: ground based and airborne
- Real time control of autonomous machines



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5G in agriculture – Low latency high data rates

Remote monitoring:

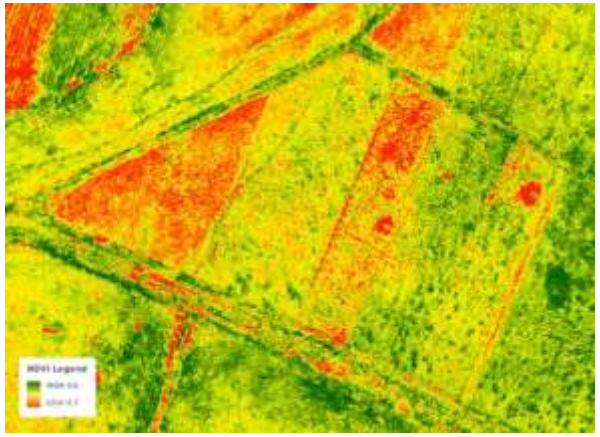
- IOT field and animal sensors
- Swarm vehicle telemetry

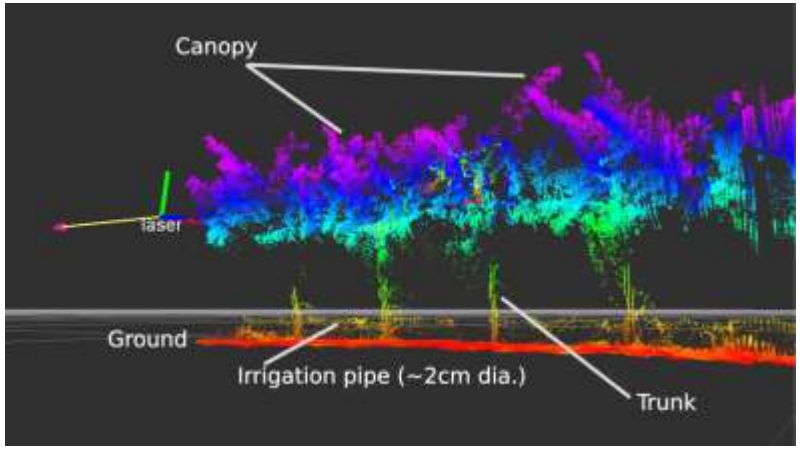
Server based analysis of:

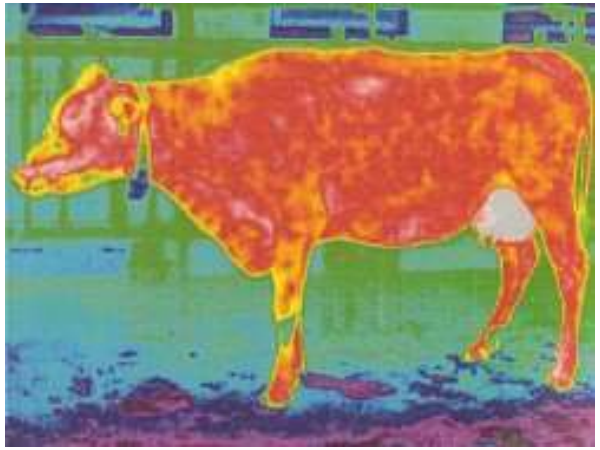
- High-Res multispectral field imagery
- Canopy 3D point clouds
- Animal behaviour
- HD video streams (multiple simultaneously)

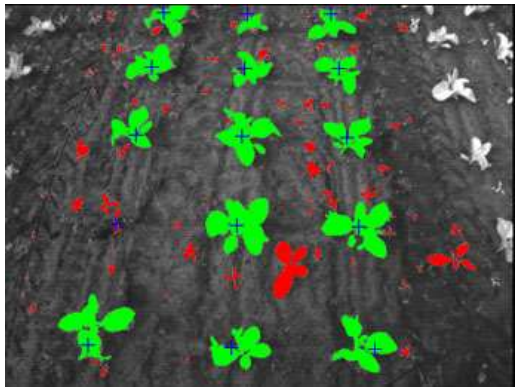
Server based real time control of:

- Targeted applications e.g. spot spraying
- Swarm vehicle navigation









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Hands Free Hectare – 5G system

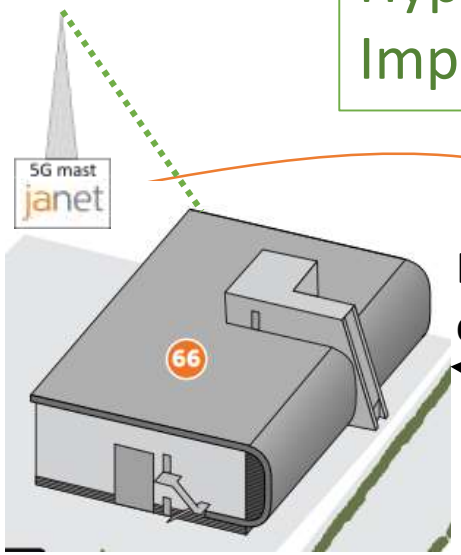
Gate-Way

Multi Channel HD Video
Telemetry
RTK correction
Laser data
Hyper Spectral
Implement command

GPS

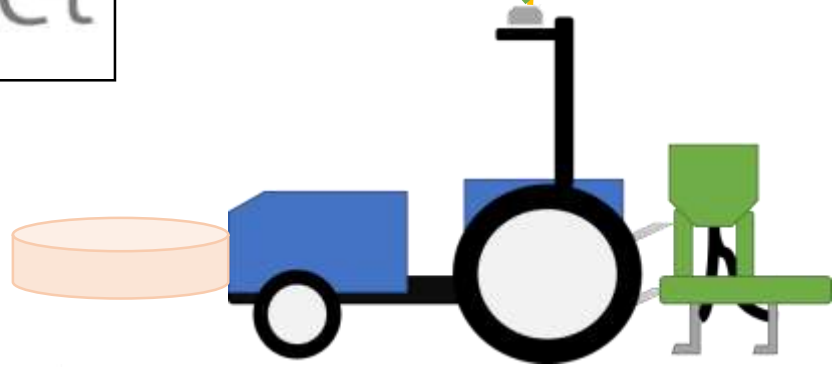
5G mast
janet

5G mast
janet



Duplicate mission across campus control to EPI

HandsFree Hectare



Campus network

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For future updates and developments

@freehectare & @AgEngResearch

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worms.drones.hours

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